U.S. DEPARTMENT OF COMMERCE
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PB-288 424

Lake Casitas
Ventura County, California

(U.S.) National Eutrophication Survey, Corvallis, OR

Prepared for

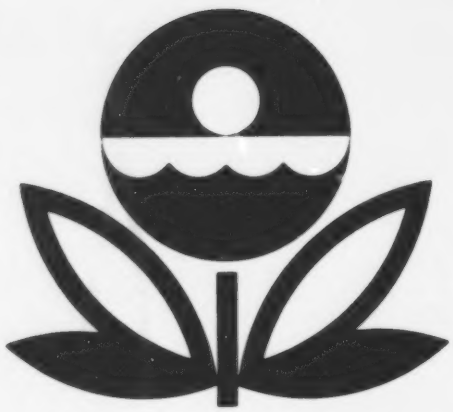
Corvallis Environmental Research Lab, OR

Jun 78

PB 288424

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES



REPORT

ON

LAKE CASITAS

VENTURA COUNTY

CALIFORNIA

EPA REGION IX

WORKING PAPER No. 742

REPRODUCED BY
NATIONAL TECHNICAL
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U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

☆G.P.O. 699-440

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO. PB288424
4. TITLE AND SUBTITLE Report on Lake Casitas, Ventura County, California		5. REPORT DATE Prepared June, 1978 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper # 742
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - Nov. '74 - Nov. '75 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		48G

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release unlimited		43
	20. SECURITY CLASS (This page)	22. PRICE PC A03 / MF A01

EPA Form 2220-1 (9-73)

REPORT
ON
LAKE CASITAS
VENTURA COUNTY
CALIFORNIA
EPA REGION IX
WORKING PAPER No. 742

WITH THE COOPERATION OF THE
CALIFORNIA STATE WATER RESOURCES CONTROL BOARD
AND THE
CALIFORNIA NATIONAL GUARD
JUNE, 1978

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentration (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGEMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U.S. Environmental Protection Agency) expresses sincere appreciation to the California State Water Resources Control Board and the nine Regional Water Quality Control Boards for professional involvement, to the California National Guard for conducting the tributary sampling phase of the Survey, and to those California wastewater treatment plant operators who voluntarily provided effluent samples and flow data.

The staff of the Division of Planning and Research of the State Water Resources Control Board provided invaluable lake documentation and counsel during the Survey, coordinated the reviews of the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

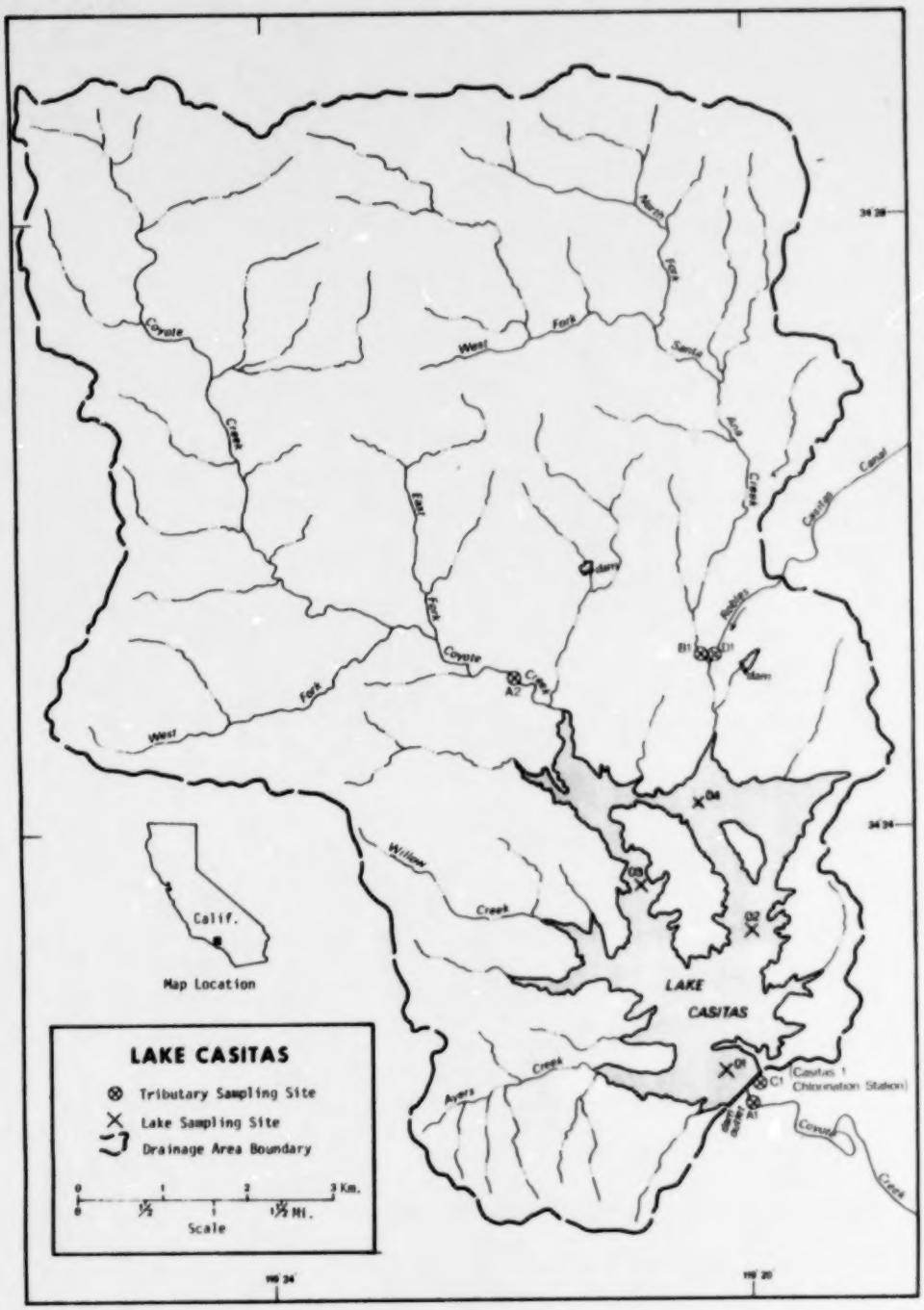
Major General Glen C. Ames, the Adjutant General of California, and Project Officer Second Lieutenant Terry L. Barrie, who directed the volunteer efforts of the California National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY RESERVOIRS

State of California

Name	County
Amador	Amador
Boca	Nevada
Britton	Shasta
Casitas	Ventura
Crowley	Mono
Don Pedro	Tuolumne
Elsinore	Riverside
Fallen Leaf	El Dorado
Hennessey	Napa
Henshaw	San Diego
Iron Gate	Siskiyou
Lopez	San Luis Obispo
Mary	Mono
Mendocino	Mendocino
Nicasio	Marin
Lower Otay	San Diego
Pillsbury	Lake
Santa Margarita	San Luis Obispo
Shasta	Shasta
Shaver	Fresno
Silver	Mono
Tahoe	El Dorado, Placer, CA; Carson City, Douglas, Washoe, NV
Tulloch	Calaveras, Tuolumne
Lower Twin	Mono
Upper Twin	Mono


Coyote
Creek
West
Fork
North
Fork
Santa
Ana
Creek
Canada
Canal
East
Fork
Coyote
Creek
Dam
Reber
Dam
B1
D1
A2
West
Fork
D4
Willow
Creek
LAKE
CASITAS
D3
B2
Ayers
Creek
Casitas 1
Chlorination Station
C1
Dam
Cañada
Creek
Calif.
Map Location
LAKE CASITAS
Tributary Sampling Site
Lake Sampling Site
Drainage Area Boundary
0 1 2 3 Km.
0 1/2 1 1 1/2 Mi.
Scale
3428
3424
119 24
119 20

LAKE CASITAS
STORET NO. 0604

I. CONCLUSIONS

A. Trophic Condition*:

Survey data indicate that Lake Casitas is eutrophic. It ranked twelfth in overall trophic quality when the 24 California lakes and reservoirs sampled in 1975 were compared using a combination of six parameters**. Thirteen of the water bodies had less median total phosphorus, 14 had less and one had the same median dissolved orthophosphorus, six had less and one had the same median inorganic nitrogen, seven had less mean chlorophyll a, and twelve had greater mean Secchi disc transparency. Marked depression of dissolved oxygen occurred with depth at sampling stations 1, 2, and 3 in November.

Survey limnologists did not observe algal concentrations or macrophytes in the reservoir at any sampling time; however, copper sulfate is applied occasionally for control of algae (Bailey, 1977).

B. Rate-Limiting Nutrient:

Due to nutrient changes in the samples during shipment from the field to the laboratory, the algal assay results are not considered representative of conditions in the reservoir at the times the samples were collected.

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* Trophic assessment is based on levels of nutrients, dissolved oxygen, and chlorophyll a; phytoplankton kinds and numbers; and transparency (Allum et al., 1977).

** See Appendix A.

The reservoir data indicate nitrogen limitation all three sampling times.

C. Nutrient Controllability:

1. Point sources--No known wastewater treatment plants impacted Lake Casitas during the sampling year. Septic tanks serving shoreline dwellings and recreational areas added an estimated 6.0% of the total phosphorus load, but a shoreline survey would be needed to determine the significance of those sources.

The phosphorus loading of 0.04 g/m^2 measured during the sampling year is less than that proposed by Vollenweider (Vollenweider and Dillon, 1974) as an oligotrophic loading (see page 12). However, the eutrophic condition of the reservoir and the apparent loss of phosphorus during the sampling year (page 10) indicate an underestimation of phosphorus inputs. This could have been the result of the operation of the Robles-Casitas diversion canal which has contributed 50 percent of the water stored in the lake in past years (Johns, 1975). Since only two samples were taken from the canal, it appears that diversion of water to Lake Casitas was minimal during the sampling year. If so, the phosphorus load contributed by the canal was much less than would be input during a normal diversion year, and a phosphorus loss could have occurred because of "wash-out" during a period of abnormally low diversion and resulting low phosphorus input.

2. Non-point sources--The phosphorus contributions of non-point sources, including direct precipitation, amounted to 94.0% of the total load. Coyote Creek added 16.7%, and the ungaged minor tributaries and immediate drainage contributed an estimated 32.1%.

The phosphorus export rate of Coyote Creek was a low 2 kg/km^2 during the sampling year (see page 11).

II. RESERVOIR AND DRAINAGE BASIN CHARACTERISTICS†

A. Morphometry††:

1. Surface area: 10.97 kilometers^2.
2. Mean depth: 28.6 meters.
3. Maximum depth: 86.9 meters.
4. Volume: 313.742 x 10^6 m^3.
5. Mean hydraulic retention time: 19.1 years.

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Coyote Creek	34.2	0.191
Minor tributaries & immediate drainage -	44.2	0.331
Totals	78.4	0.522

2. Outlets - Aqueducts - 0.522
   Coyote Creek 89.4 -
   Totals 89.4** 0.522**

C. Precipitation***:

1. Year of sampling: 26.6 centimeters.
2. Mean annual: 36.2 centimeters.

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† Table of metric equivalents--Appendix B.
†† At maximum pool; Martin and Hansen, 1966.
* For limits of accuracy; see Working Paper No. 175, "... Survey Methods, 1973-1976".
** Includes area of reservoir; outflow adjusted to equal sum of inflows.
*** See Working Paper No. 175.

III. WATER QUALITY SUMMARY

Lake Casitas was sampled three times during the open-water season of 1975 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from a number of depths at four stations on the reservoir (see map, page v). During each visit, a single depth-integrated (4.6 m to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 60.4 meters at station 1, 52.4 meters at station 2, 46.6 meters at station 3, and 28.0 meters at station 4.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR CASITAS RESERVOIR
STORET CODE 0604

PARAMETER	1ST SAMPLING (3/ 7/75) 4 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (6/24/75) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (11/13/75) 4 SITES RANGE	MEAN	MEDIAN
TEMP (C)	10.6 - 12.1	11.4	11.1	12.1 - 20.3	16.3	15.9	12.9 - 17.4	16.6	17.3
DISS OXY (MG/L)	8.2 - 10.0	9.0	8.7	4.8 - 10.2	7.8	7.8	1.0 - 11.6	6.3	7.2
CNDCTVY (MCROMO)	579. - 612.	593.	591.	470. - 565.	522.	515.	398. - 500.	459.	460.
PH (STAND UNITS)	8.1 - 8.5	8.3	8.2	7.6 - 8.1	7.8	7.7	7.6 - 8.4	8.0	8.0
TOT ALK (MG/L)	135. - 148.	143.	144.	139. - 151.	145.	145.	130. - 147.	138.	136.
TOT P (MG/L)	0.023 - 0.130	0.034	0.029	0.020 - 0.396	0.045	0.031	0.017 - 0.045	0.029	0.021
ORTHO P (MG/L)	0.012 - 0.026	0.018	0.017	0.004 - 0.037	0.014	0.012	0.005 - 0.042	0.018	0.010
NO2+NO3 (MG/L)	0.020 - 0.100	0.054	0.060	0.020 - 0.200	0.059	0.025	0.020 - 0.270	0.061	0.020
AMMONIA (MG/L)	0.020 - 0.030	0.021	0.020	0.020 - 0.050	0.024	0.020	0.020 - 0.030	0.020	0.020
KJEL N (MG/L)	0.200 - 0.600	0.263	0.200	0.200 - 0.600	0.310	0.300	0.200 - 0.200	0.200	0.200
INORG N (MG/L)	0.040 - 0.120	0.075	0.040	0.040 - 0.250	0.084	0.055	0.040 - 0.290	0.081	0.040
TOTAL N (MG/L)	0.220 - 0.620	0.317	0.280	0.220 - 0.620	0.374	0.355	0.220 - 0.470	0.261	0.220
CHLRPYL A (UG/L)	0.8 - 4.8	3.3	3.8	2.0 - 5.7	3.8	3.8	2.1 - 2.8	2.4	2.4
SECCHI (METERS)	1.8 - 4.4	2.7	2.4	2.1 - 2.4	2.3	2.4	******	**********	

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
03/07/75	1. Chroomonas (?) sp.	268
	2. Ankistrodesmus sp.	239
	3. Scenedesmus sp.	89
	Total	596
06/24/75	1. Dinobryon sp.	2,973
	2. Chroomonas (?) sp.	125
	Total	3,098
11/13/75	1. Cyclotella sp.	1,453
	2. Melosira sp.	305
	3. Chroomonas sp.	229
	4. Cryptomonas sp.	152
	5. Ankistrodesmus sp.	152
	Other genera	386
	Total	2,677

2. Chlorophyll *a* -

Sampling Date	Station Number	Chlorophyll *a* (µg/l)
03/07/75	1	0.8
	2	4.1
	3	4.8
	4	3.6
06/24/75	1	3.5
	2	4.1
	3	2.0
	4	5.7
11/13/75	1	2.8
	2	2.3
	3	2.1
	4	2.5

C. Limiting Nutrient Study:

Due to significant changes in nutrient levels in the samples during shipment from the field to the laboratory, the algal assay results are not considered representative of conditions in the reservoir at the times the samples were collected (03/07/75 and 11/13/75).

The reservoir data indicate nitrogen limitation all three sampling times. The mean inorganic nitrogen/orthophosphorus ratios were 4/1 in March, 6/1 in June, and 4/1 in November.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the California National Guard collected monthly near-surface grab samples when possible from each of the tributary sites indicated on the map (page v). Sampling was begun in November, 1974, and was completed in April, 1975.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the California District Office of the U.S. Geological Survey for the tributary sites nearest the reservoir.

In this report, nutrient loads for Coyote Creek at station A-2 were calculated using mean annual concentrations and mean annual flows. The outlet load was calculated using mean annual concentrations at station C-1 and the mean annual outlet flows.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the mean concentrations in Coyote Creek and Santa Ana Creek at stations A-2 and B-1 and the mean annual ZZ flow.

No known wastewater treatment plants impacted Lake Casitas during the sampling year.

A. Waste Sources:

1. Known municipal - None

2. Known industrial - None

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/yr	% of total
a. Tributaries (non-point load) -		
Coyote Creek	70	16.7
b. Minor tributaries & immediate drainage (non-point load) -	135	32.1
c. Known municipal STP's - None	-	-
d. Septic tanks* -	25	6.0
e. Known industrial - None	-	-
f. Direct precipitation** -	190	45.2
Total	420	100.0

2. Outputs -

Reservoir outlets -	Aqueducts	445
	Coyote Creek	-
	Total	445

3. Net annual P loss - 25 kg.

* Estimate based on five picnic areas, eight campgrounds, and 12 shoreline dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/yr	% of total
a. Tributaries (non-point load) -		
Coyote Creek	2,980	12.3
b. Minor tributaries & immediate drainage (non-point load) -	8,610	35.4
c. Known municipal STP's - None	-	-
d. Septic tanks* -	865	3.6
e. Known industrial - None	-	-
f. Direct precipitation** -	11,845	48.7
Total	24,300	100.0

2. Outputs -

Reservoir outlets -	Aqueducts	14,865
	Coyote Creek	-
	Total	14,865

3. Net annual N accumulation - 9,435 kg.

D. Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km^2/yr	kg N/km^2/yr
Coyote Creek	2	87

E. Mean Nutrient Concentrations in Ungaged Streams:

Tributary	Mean Total P Conc. (mg/l)	Mean Total N Conc. (mg/l)
Santa Ana Creek	0.014	1.222
Robles-Casitas Canal	0.020	0.530

* Estimate based on five picnic areas, eight campgrounds, and 12 shoreline dwellings; see Working Paper No. 175.
** See Working Paper No. 175.

F. Yearly Loads:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m^2/yr	0.04	loss*	2.2	0.9

Vollenweider phosphorus loadings ($g/m^2/yr$) based on mean depth and mean hydraulic retention time of Lake Casitas:	
"Dangerous" (eutrophic loading)	0.24
"Permissible" (oligotrophic loading)	0.12

* There was an apparent loss of phosphorus during the sampling year. This may have been due to solubilization of previously sedimented phosphorus, recharge with phosphorus-rich ground water, or (probably) insufficient tributary sampling.

V. LITERATURE REVIEWED

Allum, M.O., R.E. Glessner, and J.H. Gakstatter, 1977. An evaluation of the National Eutrophication Survey data. Working Paper No. 900, Corvallis Env. Res. Lab., Corvallis, OR.

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Vollenweider, R. A., and P. J. Dillon, 1974. The application of the phosphorus loading concept to eutrophication research. Natl. Res. Council of Canada Publ. No. 13690, Canada Centre for Inland Waters, Burlington, Ontario.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
0601	AMADOR RESERVOIR	0.040	0.390	408.667	22.383	14.600	0.020
0602	BOCA LAKE	0.012	0.040	372.833	1.700	6.800	0.003
0603	LAKE BRITTON	0.067	0.115	448.500	4.811	11.200	0.047
0604	CASITAS RESERVOIR	0.029	0.050	400.250	3.192	14.000	0.014
0605	CROWLEY LAKE	0.046	0.045	374.750	5.600	12.200	0.034
0606	DON PEDRO RESERVOIR	0.013	0.060	381.733	3.564	11.400	0.004
0607	LAKE ELSINORE	0.469	0.120	489.214	70.572	8.000	0.092
0608	FALLEN LEAF RESERVOIR	0.007	0.040	24.357	0.786	8.800	0.005
0609	LAKE HENNESSEY	0.027	0.060	416.000	4.525	15.000	0.012
0610	LAKE HENSHAW	0.138	0.070	461.000	26.783	9.800	0.073
0611	IRON GATE RESERVOIR	0.184	0.690	440.333	6.217	13.800	0.124
0614	LOPEZ LAKE	0.371	0.090	372.000	8.658	15.000	0.343
0615	LAKE MARY	0.010	0.040	296.000	2.550	10.600	0.002
0616	LAKE MENDOCINO	0.020	0.050	436.500	3.100	9.400	0.008
0617	NICASIO RESERVOIR	0.055	0.345	482.778	6.633	9.800	0.013
0618	LOWER OTAY RESERVOIR	0.058	0.180	447.250	15.933	15.000	0.013
0619	LAKE PILLSBURY	0.022	0.060	466.667	6.389	8.200	0.008
0620	SANTA MARGARITA LAKE	0.037	0.070	400.000	9.122	14.800	0.014
0621	SHASTA LAKE	0.021	0.060	381.542	4.087	9.000	0.015
0622	SHAVER	0.014	0.060	346.400	1.700	7.400	0.004
0623	SILVER LAKE	0.012	0.055	356.000	1.800	7.000	0.003
0624	TULLOCK RESERVOIR	0.025	0.060	433.000	13.878	7.400	0.009
0625	UPPER TWIN LAKES	0.015	0.040	300.200	3.340	7.400	0.004
0626	LOWER TWIN LAKES	0.014	0.040	248.000	2.900	11.400	0.003

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NU
0601	AMADOR RESERVOIR	35 (8)	4 (1)	43 (10)	9 (2)	17 (4)	26 (6)	134
0602	BOCA LAKE	89 (20)	98 (22)	70 (16)	91 (21)	100 (23)	91 (20)	539
0603	LAKE BRITTON	17 (4)	22 (5)	17 (4)	48 (11)	43 (10)	17 (4)	164
0604	CASITAS RESERVOIR	43 (10)	74 (17)	48 (11)	70 (16)	22 (5)	37 (8)	294
0605	CROWLEY LAKE	30 (7)	78 (18)	65 (15)	43 (10)	30 (7)	22 (5)	268
0606	DON PEDRO RESERVOIR	83 (19)	54 (11)	57 (13)	61 (14)	37 (8)	78 (17)	370
0607	LAKE ELSINORE	0 (0)	17 (4)	0 (0)	0 (0)	78 (18)	9 (2)	104
0608	FALLEN LEAF RESERVOIR	100 (23)	87 (19)	100 (23)	100 (23)	70 (16)	70 (16)	527
0609	LAKE HENNESSEY	48 (11)	54 (11)	39 (9)	52 (12)	4 (0)	52 (12)	249
0610	LAKE HENSHAW	13 (3)	33 (7)	13 (3)	4 (1)	54 (12)	13 (3)	130
0611	IRON GATE RESERVOIR	9 (2)	0 (0)	26 (6)	39 (9)	26 (6)	4 (1)	104
0614	LOPEZ LAKE	4 (1)	26 (6)	74 (17)	26 (6)	4 (0)	0 (0)	134
0615	LAKE MARY	96 (22)	87 (19)	91 (21)	83 (19)	48 (11)	100 (23)	505
0616	LAKE MENDOCINO	65 (15)	70 (16)	30 (7)	74 (17)	61 (14)	63 (14)	363
0617	NICASIO RESERVOIR	26 (6)	9 (2)	4 (1)	30 (7)	54 (12)	46 (10)	169
0618	LOWER OTAY RESERVOIR	22 (5)	13 (3)	22 (5)	13 (3)	4 (0)	46 (10)	120
0619	LAKE PILLSBURY	57 (13)	41 (9)	9 (2)	35 (8)	74 (17)	63 (14)	274
0620	SANTA MARGARITA LAKE	39 (9)	33 (7)	52 (12)	22 (5)	13 (3)	37 (8)	196
0621	SHASTA LAKE	61 (14)	54 (11)	61 (14)	57 (13)	65 (15)	30 (7)	328
0622	SHAVER	78 (18)	41 (9)	83 (19)	96 (22)	87 (19)	78 (17)	463
0623	SILVER LAKE	89 (20)	65 (15)	78 (18)	87 (20)	96 (22)	91 (20)	506
0624	TULLOCK RESERVOIR	52 (12)	54 (11)	35 (8)	17 (4)	87 (19)	57 (13)	302
0625	UPPER TWIN LAKES	70 (16)	98 (22)	87 (20)	65 (15)	87 (19)	78 (17)	485
0626	LOWER TWIN LAKES	74 (17)	87 (19)	96 (22)	78 (18)	37 (8)	91 (20)	463

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	0602	BOCA LAKE	539
2	0608	FALLEN LEAF RESERVOIR	527
3	0623	SILVER LAKE	506
4	0615	LAKE MARY	505
5	0625	UPPER TWIN LAKES	485
6	0626	LOWER TWIN LAKES	463
7	0622	SHAVER	463
8	0606	DON PEDRO RESERVOIR	370
9	0616	LAKE MENDOCINO	363
10	0621	SHASTA LAKE	328
11	0624	TULLOCK RESERVOIR	302
12	0604	CASITAS RESERVOIR	294
13	0619	LAKE PILLSBURY	279
14	0605	CROWLEY LAKE	268
15	0609	LAKE HENNESSEY	249
16	0620	SANTA MARGARITA LAKE	196
17	0617	NICASIO RESERVOIR	169
18	0603	LAKE BRITTON	164
19	0614	LOPEZ LAKE	134
20	0601	AMADOR RESERVOIR	134
21	0610	LAKE HENSHAW	130
22	0618	LOWER OTAY RESERVOIR	120
23	0607	LAKE ELSINORE	104
24	0611	IRON GATE RESERVOIR	104

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 - cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR CALIFORNIA 09/24/76

LAKE CODE 0604 LAKE CASITAS

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 89.4

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
0604A1	89.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0604A2	34.2	0.583	0.926	0.213	0.138	0.048	0.029	0.017	0.010	0.008	0.009	0.111	0.253	0.191
0604ZZ	55.2	0.997	1.608	0.371	0.234	0.080	0.042	0.021	0.011	0.008	0.011	0.222	0.462	0.331

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 89.4
SUM OF SUB-DRAINAGE AREAS = 89.4
TOTAL FLOW IN = 6.41
TOTAL FLOW OUT = 0.0

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
0604A1	11	74	0.0	16	0.0				
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0	23	0.0				
	4	75	0.0	13	0.0				
	5	75	0.0						
	6	75	0.0						
	7	75	0.0						
	8	75	0.0						
	9	75	0.0						
	10	75	0.0						
0604A2	11	74	0.011	16	0.012				
	12	74	0.221	8	0.037				
	1	75	0.033	25	0.028				
	2	75	0.249						
	3	75	0.767	23	0.221				
	4	75	0.143	13	0.150	27	0.110		
	5	75	0.072						
	6	75	0.046						
	7	75	0.024						
	8	75	0.010						
	9	75	0.008						
	10	75	0.007						
0604ZZ	11	74	0.011						
	12	74	0.411						
	1	75	0.085						
	2	75	0.496						
	3	75	1.472						
	4	75	0.283						
	5	75	0.127						
	6	75	0.057						
	7	75	0.042						
	8	75	0.008						
	9	75	0.008						
	10	75	0.006						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/09/24

060401
34 22 25.0 119 20 15.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0139 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/07	10 40	0000	10.6	8.8	174	585	8.30	148	0.030	0.500	0.050	0.022
	10 40	0005	11.1	8.4		591	8.30	147	0.020K	0.200	0.060	0.022
	10 40	0015	11.0	8.6		608	8.20	146	0.020K	0.200K	0.070	0.022
	10 40	0035	11.0	8.6		605	8.20	145	0.020K	0.200	0.080	0.023
	10 40	0070	11.0	8.6		605	8.20	145	0.020K	0.200	0.080	0.024
	10 40	0105	10.9	8.6		598	8.20	145	0.020K	0.400	0.080	0.024
	10 40	0135	10.9	8.4		588	8.20	146	0.020K	0.300	0.090	0.024
75/06/24	12 20	0000	19.2	9.4	84	565	8.10	150	0.040	0.600	0.020K	0.010
	12 20	0005	19.1	9.6		565	8.00	140	0.020	0.400	0.020	0.006
	12 20	0015	18.6	9.6		550	8.00	143	0.020	0.500	0.020K	0.006
	12 20	0040	15.9	8.2		520	7.90	141	0.020K	0.300	0.050	0.014
	12 20	0080	14.7	7.4		510	7.80	144	0.020	0.300	0.060	0.025
	12 20	0120	13.1	6.3		500	7.80	143	0.020K	0.400	0.110	0.027
	12 20	0160	12.2	5.4		490	7.70	144	0.020K	0.300	0.160	0.032
	12 20	0198	12.1	4.8		490	7.70	143	0.020K	0.300	0.190	0.024
75/11/13	09 00	0000	17.3	7.0		459	8.45	141	0.020K	0.200K	0.020	0.021
	09 00	0005	17.3	7.2		457	8.25	139	0.020K	0.200K	0.020	0.009
	09 00	0019	17.3	7.0		500	8.10	141	0.020K	0.200K	0.020	0.010
	09 00	0050	17.3	7.0		464	8.00	143	0.020K	0.200K	0.020	0.011
	09 00	0095	17.3	6.8		475	7.95	141	0.020K	0.200K	0.020	0.014
	09 00	0140	16.6	5.4		441	8.00	142	0.020K	0.200	0.120	0.033
	09 00	0160	13.1	2.0		398	7.80	143	0.020K	0.200K	0.240	0.042
	09 00	0197	12.9	1.4		409	7.60	143	0.020K	0.200K	0.270	0.045

K= VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060401
34 22 25.0 119 20 15.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0139 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/07	10 40	0000	0.033	0.8	
	10 40	0005	0.026		
	10 40	0015	0.029		
	10 40	0035	0.030		
	10 40	0070	0.029		
	10 40	0105	0.029		
	10 40	0135	0.029		
75/06/24	12 20	0000	0.035	3.5	
	12 20	0005	0.028		
	12 20	0015	0.027		
	12 20	0040	0.028		
	12 20	0080	0.036		
	12 20	0120	0.037		
	12 20	0160	0.041		
	12 20	0198	0.062		
75/11/13	09 00	0000	0.030	2.8	
	09 00	0005	0.018		
	09 00	0019	0.019		
	09 00	0050	0.019		
	09 00	0095	0.022		
	09 00	0140	0.038		
	09 00	0160	0.057		
	09 00	0197	0.066		

STORET RETRIEVAL DATE 76/09/24

060402
34 22 25.0 119 20 15.0 3
CASITAS RESERVOIR
06111 CALIFORNIA

140591

11EPALES 2111202
0144 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/07	11	42 0000	11.6	10.0	96	588	8.50	145	0.020K	0.400	0.020K	0.014
	11	42 0005	11.7	9.8		604	8.50	144	0.020K	0.300	0.020K	0.014
	11	42 0015	11.8	9.6		583	8.45	143	0.020K	0.300	0.020K	0.015
	11	42 0040	11.2	8.8		581	8.20	144	0.020K	0.300	0.060	0.026
	11	42 0070	11.0	8.6		579	8.20	143	0.020K	0.200K	0.080	0.024
	11	42 0100	10.9	8.4		583	8.20	145	0.020K	0.200K	0.080	0.023
	11	42 0110	10.9	8.2		586	8.20	146	0.020K	0.200K	0.080	0.023
	11	42 0130	10.9	8.2		597	8.20	135	0.020K	0.200K	0.100	0.023
75/06/24	15	10 0000	19.8		96	555	7.70	140	0.020K	0.600	0.020K	0.007
	15	10 0005	19.8	10.2		555	7.80	142	0.020	0.500	0.020K	0.006
	15	10 0015	19.5	9.4		535	7.80	139	0.020K	0.300	0.020K	0.006
	15	10 0040	15.9	7.8		510	7.80	142	0.020K	0.300	0.040	0.014
	15	10 0070	15.0	6.8		500	7.70	144	0.020	0.200K	0.040	0.016
	15	10 0100	14.3	6.2		490	7.60	145	0.020	0.200K	0.030	0.017
	15	10 0135	12.6	4.8		470	7.60	144	0.030	0.200	0.180	0.037
	15	10 0172	12.3	4.8		470	7.60	145	0.050	0.300	0.200	0.027
75/11/13	09	30 0000	17.3	7.2		460	8.00	134	0.020K	0.200K	0.030	0.009
	09	30 0005	17.3	7.2		458	8.10	136	0.020K	0.200K	0.020K	0.006
	09	30 0019	17.3	8.4		490	8.40	138	0.020K	0.200K	0.020K	0.006
	09	30 0050	17.3	7.0		492	8.10	134	0.020K	0.200K	0.020	0.012
	09	30 0095	17.3	7.2		472	8.00	138	0.020K	0.200K	0.020	0.013
	09	30 0140	15.4	3.2		439	7.70	146	0.020K	0.200K	0.160	0.031
	09	30 0162	13.1	1.4		428	7.60	147	0.030	0.200K	0.220	0.031

K= VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060402
34 22 25.0 119 20 15.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0144 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/07	11	42 0000	0.027	4.1	
	11	42 0005	0.029		
	11	42 0015	0.031		
	11	42 0040	0.029		
	11	42 0070	0.029		
	11	42 0100	0.029		
	11	42 0110	0.027		
	11	42 0130	0.027		
75/06/24	15	10 0000	0.021	4.1	
	15	10 0005	0.024		
	15	10 0015	0.027		
	15	10 0040	0.027		
	15	10 0070	0.031		
	15	10 0100	0.031		
	15	10 0135	0.045		
	15	10 0172	0.396		
75/11/13	09	30 0000	0.020	2.3	
	09	30 0005	0.017		
	09	30 0019	0.018		
	09	30 0050	0.022		
	09	30 0095	0.023		
	09	30 0140	0.039		
	09	30 0162	0.042		

STORET RETRIEVAL DATE 76/09/24

060403
34 23 53.0 119 20 54.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0157 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/07	15	0000	12.0	10.0	90	589	8.50	144	0.020K	0.300	0.020K	0.014
	15	0005	12.0	10.0		593	8.50	145	0.020K	0.200K	0.020K	0.014
	15	0015	12.1	10.0		589	8.50	141	0.020K	0.200K	0.020K	0.014
	15	0030	11.9	9.4		599	8.45	141	0.020K	0.200K	0.020K	0.013
	15	0055	11.5	8.6		604	8.20	142	0.020	0.200K	0.050	0.017
	15	0085	11.1	8.2		603	8.20	141	0.030	0.300	0.070	0.012
	15	0115	11.1	8.6		612	8.15	140	0.020	0.200K	0.080	0.017
	15	0145	11.1	8.6		586	8.15	140	0.020	0.200K	0.080	0.016
75/06/24	15	0000	20.2	9.6	90	560	7.70	146	0.030	0.400	0.030	0.007
	15	0005	19.7	10.2		555	7.80	147	0.020	0.200	0.020K	0.004
	15	0015	17.7	9.2		540	7.80	147	0.030	0.200	0.020K	0.006
	15	0040	15.6	7.8		525	7.70	149	0.030	0.200K	0.020	0.010
	15	0080	14.7	7.6		515	7.70	149	0.030	0.200	0.030	0.013
	15	0115	13.6	6.0		505	7.60	151	0.020	0.200	0.040	0.021
	15	0151	12.6	5.0		500	7.70	151	0.020	0.200K	0.170	0.024
75/11/13	10	0000	17.4	7.4		469	8.10	131	0.020K	0.200K	0.020K	0.008
	10	0005	17.3	7.2		465	8.00	133	0.020K	0.200K	0.020	0.007
	10	0021	17.3	7.0		451	8.00	130	0.020K	0.200K	0.020K	0.009
	10	0050	17.3	7.2		481	8.00	131	0.020K	0.200K	0.020K	0.010
	10	0095	17.3	7.2		481	8.00	131	0.020K	0.200K	0.020K	0.013
	10	0140	16.4	4.4		424	7.80	135	0.020K	0.200K	0.080	0.039
	10	0153	13.6	1.0		450	7.80	147	0.020K	0.200K	0.160	0.082

K= VALUE KNOWN TO BE LESS
THAN INDICATED

27

STORET RETRIEVAL DATE 76/09/24

060403
34 23 53.0 119 20 54.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0157 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCOT LT REMNING PERCENT
75/03/07	15	15 0000	0.028	4.8	
	15	15 0005	0.026		
	15	15 0015	0.028		
	15	15 0030	0.025		
	15	15 0055	0.026		
	15	15 0085	0.130		
	15	15 0115	0.036		
	15	15 0145	0.056		
75/06/24	15	35 0000	0.038	2.0	
	15	35 0005	0.032		
	15	35 0015	0.030		
	15	35 0040	0.030		
	15	35 0080	0.031		
	15	35 0115	0.039		
	15	35 0151	0.045		
75/11/13	10	15 0000	0.023	2.1	
	10	15 0005	0.017		
	10	15 0021	0.018		
	10	15 0050	0.019		
	10	15 0095	0.023		
	10	15 0140	0.044		
	10	15 0153	0.095		

STORET RETRIEVAL DATE 76/09/24

060404
34 24 07.0 119 20 27.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0090 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
75/03/07	14 45	0000	12.0	9.8	72	590	8.50	138	0.020K	0.600	0.020K	0.013
	14 45	0005	12.1	9.2		590	8.50	140	0.020K	0.300	0.020K	0.013
	14 45	0015	12.0	10.0		601	8.50	141	0.020K	0.200K	0.020K	0.012
	14 45	0035	11.7	10.0		586	8.40	143	0.020K	0.200	0.020	0.015
	14 45	0050	11.5	9.2		595	8.35	145	0.020K	0.300	0.050	0.015
	14 45	0070	11.1	9.0		594	8.20	146	0.020K	0.200	0.080	0.022
	14 45	0085	11.1	8.4		589	8.20	145	0.020	0.200	0.080	0.022
75/06/23	16 05	0000	20.3	9.8	96	560	7.80	144	0.020	0.500	0.020K	0.004
	16 05	0005	20.3	10.0		560	7.80	145	0.030	0.300	0.020K	0.012
	16 05	0015	19.1	10.0		545	7.80	145	0.020	0.300	0.020K	0.009
	16 05	0040	15.9	8.0		510	7.70	146	0.020K	0.200	0.020K	0.009
	16 05	0065	15.2	7.2		500	7.70	145	0.030	0.200K	0.020	0.013
	16 05	0092	14.7	6.8		495	7.70			0.200K		
75/11/13	09 50	0000	17.4	8.2		471	8.00	136	0.020K	0.200	0.040	0.015
	09 50	0005	17.3	7.8		451	8.10	136	0.020K	0.200K	0.020K	0.008
	09 50	0016	17.3	7.8		431	8.10	136	0.020K	0.200K	0.020K	0.007
	09 50	0035	17.3	7.6		448	8.10	136	0.020K	0.200K	0.020K	0.006
	09 50	0060	17.2	7.4		494	8.10	135	0.020K	0.200K	0.020K	0.005
	09 50	0088	16.9	11.6		490	8.10	135	0.020K	0.200K	0.020K	0.006

K= VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060404
34 24 07.0 119 20 27.0 3
CASITAS RESERVOIR
06111 CALIFORNIA
140591

11EPALES 2111202
0090 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
75/03/07	14 45	0000	0.029	3.6	
	14 45	0005	0.029		
	14 45	0015	0.023		
	14 45	0035	0.024		
	14 45	0050	0.036		
	14 45	0070	0.040		
	14 45	0085	0.037		
75/06/23	16 05	0000	0.031	5.7	
	16 05	0005	0.023		
	16 05	0015	0.022		
	16 05	0040	0.024		
	16 05	0065	0.020		
	16 05	0092	0.039		
75/11/13	09 50	0000	0.024	2.5	
	09 50	0005	0.019		
	09 50	0016	0.019		
	09 50	0035	0.020		
	09 50	0060	0.019		
	09 50	0088	0.019		

APPENDIX E

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/09/24

0604A2
34 25 00.0 119 22 00.0 4
COYOTE CREEK
06 VENTURA CO MAP
T/LAKE CASITAS 140591
CASITAS PASS RD AT GGING STATION
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	12	15	0.030	0.500	0.005K	0.010	0.010
74/12/08	09	00	0.248	0.200	0.008K	0.005	0.010K
75/01/25	13	00	0.056	0.200	0.005K	0.005K	0.010K
75/03/23	12	00	0.100	0.500	0.010	0.005K	0.010K
75/04/13	12	00	0.045	0.725	0.020	0.010	0.025
75/04/27	11	00	0.015	0.350	0.015	0.005K	0.010

K= VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

060431
34 25 10.0 119 21 30.0 4
SANTA ANA CREEK
06 VENTURA CO HWY
T/LAKE CASITAS 140591
BALDWIN RD BRDG .1 M W SANTA ANA RD JCT
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/12/08	08	20	0.336	2.100	0.045	0.015	0.020
75/01/25	12	35	0.040	0.200	0.005K	0.020	0.020
75/03/23	10	30	0.015	1.700	0.015	0.005K	0.010K
75/04/13	10	30	0.010	0.650	0.025	0.010	0.010
75/04/27	10	00	0.010	1.050	0.020	0.010	0.010

K= VALUE KNOWN TO BE LESS
THAN INDICATED

STORET RETRIEVAL DATE 76/09/24

0604C1
34 22 05.0 119 20 00.0 4
MUNICIPLE WATER SUPPLY INTAKE
06 VENTURA CO MAP
O/LAKE CASITAS 140591
AT BASE OF CASITAS DAM
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
74/11/16	10 40		0.018	0.700	0.020	0.010	0.020
74/12/08	08 00		0.048	1.100	0.030	0.020	0.020
75/01/25	14 35		0.064	0.200	0.015	0.028	0.030
75/03/23	09 00		0.086	1.000	0.015	0.040	0.040
75/04/13	09 00		0.105	1.000	0.030	0.030	0.030
75/04/27	09 00		0.095	1.000	0.020	0.015	0.020

STORET RETRIEVAL DATE 76/09/24

060401
34 25 00.0 119 20 10.0 4
ROBLES-CASITAS CANAL
06 VENTURA CO MAP
T/LAKE CASITAS 140591
ST HWY 150 7 MI NW OF OAKVIEW
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/03/23	10 00		0.046	0.650	0.018	0.010	0.010
75/04/13	10 00		0.015	0.350	0.015	0.010	0.030